

FSW Branch NPR 7150.2 Compliance Guideline

This guideline applies to in-house FSW developments being accomplished under Code 582 FSW Product Development Team leadership and staff assignments. Use of relevant FSB process templates, standards and guidelines are required, under the overall direction of Code 582 mgmt.

FSB processes have been defined to accommodate all 7150 requirements plus CMMI process area criteria, with minor differences documented below as compensating for the minor differences from the driving documents. Compensating differences are to be identified as “compliant” in a mission FSW matrix with the compensating information provided as the alternative compliant solution.

For in-house FSW developments, this matrix is to be summarized as the Project-specific 7150.2 compliance matrix required under SWE-125 below.

Req #	Requirement	FSB Reference	FSW Team Compliance	FSW Resp.
[SWE-001]	This NPR shall be applied to software development, maintenance, operations, management, acquisition, and assurance activities started after its effective date of issuance.	1 This table represents the generic FSW development team actions for each 7150.2 requirement. 2 The companion FSW Team Compliance Summary template is for use within FSW reviews	Applies to all FSW initiating mission life cycle Phase B after 8/1/05. All Code 582 PDLs must develop/maintain a mission-unique 7150.2 compliance matrix summary for presentation at major FSW reviews.	FSW PDL
Organizational Capability				
[SWE-002]	The NASA Chief Engineer shall lead, maintain, and fund an Agency wide Software Engineering Initiative to advance software engineering practices.	n/a	n/a	n/a
[SWE-003]	Each Center shall maintain, staff, and implement a plan to continually advance its in-house software engineering capability and monitor the software engineering capability of its contractors, as per NASA Software Engineering Initiative Improvement Plan. Note: The requirements for the content of each Center Software Engineering Improvement Plan are defined in Chapter 5. Each Center has a current Center Software Engineering Improvement Plan on file in the Office of the Chief Engineer.	n/a GSFC EPG	n/a	n/a

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[SWE-004]	The NASA Chief Engineer shall periodically benchmark each Center's software engineering capability against its Center Software Engineering Improvement Plan. Note: Center Software Engineering Improvement Plans should be documented per Center Software Engineering Improvement Plan requirements. Capability Maturity Model® Integration (CMMI®) - systems engineering and software engineering (CMMI®-SE/SW) appraisals are the preferred benchmark for objectively measuring progress toward software engineering process improvement at NASA Centers.	FSB and FSW teams will support as required.	n/a	n/a
[SWE-005]	Each Center shall establish, document, execute, and maintain software processes.	FSW Branch Standards apply to all FSW development teams.	n/a	n/a FSW Branch
[SWE-006]	To support compliance with NASA policy and facilitate the application of resources to mitigate risk, the NASA Chief Engineer, in coordination with the Chief Safety and Mission Assurance Officer, shall maintain a process that provides, on a recurring basis, a reliable list of the Agency's programs and projects containing software.	FSW Branch updates GSFC software inventory list each year	n/a	n/a
Compliance with Laws, Policies and Requirements				
[SWE-007]	The project shall ensure that software disclosure requirements of NPD 2091.1, Inventions Made By Government Employees, are implemented by their project, section 305 of the Space Act (42 U.S.C 2457) for large business contractors, and 35 U.S.C. 200 et seq., (including section 202(c)) for small businesses, universities, and non-profits are implemented by their project.	TBD	TBD	TBD
[SWE-008]	The project shall ensure that software technology transfer requirements of NPR 2190.1, NASA Export Control Program, are implemented by the project.	n/a	Mission Project baselines the ITAR rules. The PDL applies the Project's rules to FSW activities.	FSW PDL
[SWE-009]	The project shall ensure that software external release requirements of NPR 2210.1, External Release of NASA Software, are implemented by the project.	FSB mgmt. will support the PDL during IPP processes	FSW must be registered w/ IPP. A Software User's Agreement (SUA) must be implemented to release any mission FSW-related product with any non-582 team.	FSW PDL.
[SWE-010]	The project shall ensure that the security requirements of NPD 2810.1, NASA Information Security Policy, are implemented by the project.	FSB ensures that Physical and IT security are consistently implemented.	Physical Security = LM IT Security = Code 585, LM Ground/Flight Security is driven by mission project requirements. The PDL implements the relevant parent requirements.	LM, Code 585 FSW PDL
[SWE-011]	The project shall ensure that the requirements of reasonable accommodation for individuals with disabilities per NPR 3713.1, Procedures for Providing Reasonable Accommodation for Individuals with Disabilities, are implemented by the project.	TBD	TBD	TBD

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[SWE-012]	The project shall ensure that software is accessible to individuals with disabilities as required by Section 508 of the Rehabilitation Act (29 U.S.C. 749d), as amended. Specific requirements for accessibility may be found at 36 CFR Part 1194, available at http://www.access-board.gov/sec508/508standards.htm .	TBD	TBD	TBD
Software Life Cycle Planning				
[SWE-013]	<p>The project shall develop software plan(s).</p> <p>Note: The requirement for the content of each software plan (whether stand-alone or condensed into one or more project level or software documents) is defined in Chapter 5. These include, but are not limited to:</p> <ol style="list-style-type: none"> Software development or management plan. Software configuration management plan. Software test plans. Software maintenance plans. Software assurance plans 	<p>FSB Templates:</p> <ul style="list-style-type: none"> FSW Product Plan FSW CM Plan FSW Test Plan FSW Maint. Plan <p>Code 300 SW Assurance Plan</p>	<p>For small FSW Projects, the full CM Plan is embedded into the overall FSW Product Plan Template.</p> <p>FSW Test Plan is always a separate doc.</p> <p>FSW Branch, FSW Systems Manager, Mission Project and SQE are signatories on these plans.</p>	FSW PDL SQE/300
[SWE-014]	The project shall implement and execute the software plan(s).		FSB management approves IPDT plans, and monitors execution	FSW PDL DTLs, TTL, CM, LM
[SWE-015]	<p>The project shall establish, document, and maintain at least one software cost estimate that satisfies the following conditions:</p> <ol style="list-style-type: none"> Covers the entire software life cycle. Is based on selected project attributes (e.g., assessment of the size, functionality, complexity, criticality, and risk of the software processes and products). Is based on an assessment of the technology to be used and the impact on risk, cost, and schedule. 	<p>FSB WBS Template</p> <p>FSB BOE Template (see Kequan Luu)</p>	<ul style="list-style-type: none"> Baseline FSW BOE is the cost approved by the Project at the start of Phase C. Baseline cost estimate assumes early and accurate definition of requirements and availability of dependent products from other mission subsystems. (Project holds 30% contingency) Interim replans with no overall cost impacts are maintained via FSW BSRs. Yearly POP updates enable full replans. 	FSW PDL

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[SWE-016]	The project shall document and maintain a software schedule that satisfies the following conditions: a. Coordinates with the overall project schedule. b. Documents the interactions of milestones and deliverables between software, hardware, operations, and the rest of the system.	FSW Life Cycle Schedule template for BSRs	<ul style="list-style-type: none"> Baseline High level FSW Life Cycle Schedule, including Project milestones, dependencies & deliverables, resides in the BOE, plus FSW Product Plan at time that Product Plan is baselined. High level FSW Life Cycle Schedule is additionally integrated into the Project's schedule Adherence to schedule provided monthly to the Project and FSW Branch via BSRs. Replans identified as such. 	FSW PDL
[SWE-017]	The project shall plan, track, and ensure project specific software training for project personnel.	<ul style="list-style-type: none"> FSW Team Training Requirements Template FSB Training DB OJT Training Certs 	<ul style="list-style-type: none"> FSW Team Training Requirements Matrix FSW Team Training Records (formal and OJT) for each FSW Team Civil Servant and Contractor 	FSW PDL
[SWE-018]	The project shall regularly hold reviews of software activities, status, and results with the project stakeholders and track issues to resolution.	<ul style="list-style-type: none"> BSR Template BSR Actions DB Formal FSW Reviews Templates (drafts) RFA Template FSW Team RFAs DB 	<ul style="list-style-type: none"> Branch Status Reviews & Actions Tracking Project Monthly Status AETD Champion meetings 580 bi-monthly Status Reviews Formal Mission Reviews Formal FSW Reviews RFA responses 	FSW PDL
[SWE-019]	The project shall select and document a software development life cycle or model that includes phase transition criteria for each life cycle phase (e.g., formal review milestones, informal reviews, software requirements review (SRR), preliminary design review (PDR), critical design review (CDR), test readiness reviews, customer acceptance or approval reviews).	FSW Product Plan Template	FSW Product Plan fully describes the development life cycle process & transition criteria from one phase to another.	FSW PDL
[SWE-020]	The project shall classify each of the systems and subsystems containing software in accordance with the software classifications definitions for Class A, B, C, D, E, F, G and H in Appendix B. Note: These classifications are documented in the Software Development or Management Plan as defined in Chapter 5 – SWE-102. Software Assurance also performs an independent classification assessment and the results should be compared as per NASA-STD-8739.8, NASA Software Assurance.	<p>FSB position is that all spacecraft FSW should be classified as Class B.</p> <p>FSW Product Plan Template</p>	FSW Classification is to be documented in a Project-level FSW Mgmt. Plan and in the FSW Team's Product Plan.	FSW PDL

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[SWE-021]	If a system or subsystem evolves to a higher software classification as defined in Appendix B, then the project shall update its plan to fulfill the added requirements per the Requirements Mapping Matrix.		A change to FSW classification is to be documented in a Project-level FSW Mgmt. Plan and in the FSW Team's Product Plan.	FSW PDL
[SWE-022]	The project shall ensure that software assurance is implemented by their project as per NASA-STD-8739.8, NASA Software Assurance. Note: Software assurance activities occur throughout the life of the project and, while some of the actual analyses may be performed within the project, NASA's safety and mission assurance organizations provide assurance that the products and processes are implemented according to the agreed upon plan(s). It is important to have software assurance of all software activities and products including Request for Proposals, contracts and memorandums of agreement, software plans, requirements, design, implementation, verification, validation, certification, acceptance, maintenance, operations, and retirement.		FSW team must support SQE review/audit activities.	FSW PDL with SQE/300
[SWE-023]	When a project is determined to have safety critical software, the project shall ensure that the safety requirements of NASA-STD-8719.13, Software Safety are implemented by the project.		The mission project's safety officer is responsible for identifying safety critical FSW. PDL implements the safety officers' processes regarding agreed-to safety critical s/w. V&V of safety requirements is fundamental to FSW test program.	FSW PDL FSW TTL
[SWE-024]	The project shall ensure that actual results and performance are tracked against the software plans.	BSR Template	<ul style="list-style-type: none"> • FSW Branch Status Reviews (BSRs) • Project Monthly Status • Champion Reviews • 580 Bi-monthly Reviews 	FSW PDL
[SWE-025]	The project shall ensure that corrective actions are taken and managed to closure when actual results and performance deviate from the software plans.	BSR Actions DB	<ul style="list-style-type: none"> • BSR Actions • Project actions • IRB DCRs & actions 	FSW PDL
[SWE-026]	The project shall ensure that changes to commitments (e.g., software plans) are agreed to by the affected groups and individuals.	FSW Product Plan Template	<ul style="list-style-type: none"> • Changes with schedule/cost impacts require Project-level CCR and Project level approval • Significant replans require updates to the Product Plan with approvals. This is expected to be rare. 	FSW PDL

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Commercial, Government, and Modified Off-The-Shelf Software				
[SWE-027]	<p>The project shall ensure that when COTS, GOTS, MOTS, open source, reuse, legacy, or heritage software product is to be acquired, the following conditions are satisfied:</p> <ol style="list-style-type: none"> The requirements that are to be met by the off-the-shelf software are identified. The off-the-shelf software includes documentation to fulfill its intended purpose (e.g. usage instructions). Proprietary, usage, ownership, warranty, and licensing rights are addressed including transfer. Future support for the off-the-shelf software product is planned. Off-the-shelf software is validated to the same level of confidence as would be required of the developed software. <p>Note: It is the responsibility of the organization proposing to procure off-the-shelf software to document, prior to procurement, the plan for validating that such software can be assigned the same level of confidence that would be needed for an equivalent class of software if obtained through a "development" process.</p> <p>Note: For critical systems or systems which must be maintained for long periods of time – beyond the time a supplier would maintain or support the software, the following should be considered:</p> <ol style="list-style-type: none"> Supplier agreement to deliver or escrow source code or third party maintenance agreement is in place. A risk mitigation plan to cover the following cases is available: <ol style="list-style-type: none"> Loss of supplier or third party support for the product. Loss of maintenance for the product (or product version). Loss of the product (e.g., license revoked, recall of product, etc.) Agreement that the project has access to defects discovered by the community of users has been obtained. When available, the project can join a product users group to obtain this information. The plan to provide adequate support is in place, including timely maintenance and cost of maintenance. Any changes to the software management, development, operations, or maintenance plans that are affected by the use or incorporation of COTS, GOTS, MOTS, reuse, legacy, or heritage software should be documented by the project. 	<p>OSAL, cFE, CFS applications, compilers, etc. will be pre-qualified by the very nature of their having been accepted for submission into the FSW Reuse Library via the FSRL CCB.</p> <p>RTOSs are pre-qualified by FSW RTOS experts, prior to being considered for flight. (Alan Cudmore)</p> <p>FSB FSW Reuse Rules and Controls (TBS):</p> <ul style="list-style-type: none"> FSW Product Plan FSW Requirements FSW CM FSW Requirements Inspection FSW Coding Stds. FSW Code Inspections FSW Test Plan FSW Test Artifacts 	<p>FSW from the RSRL is configured and tested according to FSB CCB controlled processes.</p> <p>Each COTS, GOTS product will additionally be certified for flight via successful performance during normal FSW V&V test program. – ie., that all mission FSW functionality, nominal and anomalous, required for the long term mission has been successfully validated in concert with the COTS, GOTS products.</p>	<p>FSW PDL</p> <p>FSW DTLs</p> <p>FSW TTL</p>

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Software Verification and Validation				
[SWE-028]	<p>The project shall plan software verification activities, methods, environments, and criteria for the project.</p> <p>Note: Software verification is a software engineering activity that demonstrates the software products meet specified requirements. Methods of software verification include: peer reviews/inspections of software engineering products for discovery of defects, software verification of requirements by use of simulations, black box and white box testing techniques, analyses of requirement implementation, and software product demonstrations. Planning for software verification should address the development, management review, and documentation for the software products. Refer to the Software Development or Management Plan software documentation requirement for software verification planning and incorporation (Chapter 5 – SWE-104).</p>	<ul style="list-style-type: none"> • FSW Product Plan Template • FSW Test Plan Template • FSW Test Artifact Templates 	<ul style="list-style-type: none"> • FSW Build Verification Test Program and testbed fidelity are described in the FSW Product Plan and FSW Test Plan. • Verification plans are described at formal mission and FSW reviews. 	<p>FSW PDL</p> <p>FSW DTL</p> <p>FSW TTL</p>
[SWE-029]	<p>The project shall plan the software validation activities, methods, environments, and criteria for the project.</p> <p>Note: Software validation is a software engineering activity that demonstrates the as-built software product or software product component fulfills its intended use in its intended environment. Methods of software validation include: peer reviews/inspections of software product component behavior in a simulated environment, acceptance testing against mathematical models, analyses, and operational environment demonstrations. Planning for software validation should address the development, maintenance, support, and training for the software product and software product components. Refer to the Software Development or Management Plan software documentation requirement for software validation planning and incorporation (Chapter 5 – SWE-104)</p>	<ul style="list-style-type: none"> • FSW Test Plan Template • FSW Test Artifact Templates 	<ul style="list-style-type: none"> • FSW Systems Validation Test Program and testbed fidelity are described in the FSW Product Plan and FSW Test Plan. • Validation plans are described at formal mission and FSW reviews. • FSW Systems Test Readiness Review (STRR) describes validation processes and system test scenarios 	<p>FSW PDL</p> <p>FSW TTL</p>
[SWE-030]	The project shall record, address, and track to closure the results of software verification activities.	<ul style="list-style-type: none"> • FSW Test PlanTemplate • FSW DCR Reqmts. • 	<ul style="list-style-type: none"> • FSW RTTM • FSW DCRs and FSW team IRB • FSW Test Artifacts 	FSW TTL
[SWE-031]	The project shall record, address, and track to closure the results of software validation activities.	<ul style="list-style-type: none"> • FSW Test Plan Template • FSW DCR Reqmts. <p>FSW Acceptance Test is the complete run of all systems tests on the highest fidelity FSW testbed using the final FSW build</p>	<ul style="list-style-type: none"> • FSW RTTM • FSW DCRs and FSW team IRB • FSW Test Artifacts • FSW Acceptance Test Results Review (ATRR) 	FSW TTL

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Project Formulation Requirements				
[SWE-032]	<p>Consistent with the Requirements Mapping Matrix (Appendix D), the project shall ensure that software is developed by either a software CMMI® Maturity Level 3 or higher organization; or by an organization that has a CMMI®-SE/SW Capability Level 2 or higher as measured by a Software Engineering Institute (SEI) authorized lead appraiser from an external organization in the following Process Areas:</p> <ul style="list-style-type: none"> a. Requirements Management. b. Configuration Management. c. Process and Product Quality Assurance. d. Measurement and Analysis. e. Project Planning. f. Project Monitoring and Control. g. Supplier Agreement Management. <p>Note: Organizations who have completed Standard CMMI® Appraisal Method for Process Improvement (SCAMPI) Class A appraisals against the CMMI® Model are expected to have their results posted on the SEI web site so that NASA can assess the current maturity state in the selection process.</p>	FSB was qualified as CMMI Capability Level 2 in all process areas, and CMMI Capability Level 3 in Risk Management (2006)	FSW teams are to follow baselined FSW Branch processes already qualified as CMMI mature	FSW PDL
<p><i>The following 7150.2 Acquisition Requirements are defined primarily for formal RFP acquisitions in which the software product is wholly procured from a contractor. In this context, the 'project' in the requirements below refers to the acquisition project team – likely influenced by the FSW Systems Manager or equivalent. Because all Code 582 work is accomplished as in-house Integrated Product Development Teams (IPDTs), the acquisition process is informal, as described in the FSW Product Plan template.</i></p> <p><i>None of the requirements below is intended for FSW task management. Because staff acquired for an IPDT via functional tasks are not responsible for the overall flight products, the decision was made by GSFC in conjunction with the CMMI auditors that acquisition in the context of IPDTs applies only to COTS and equipment purchases. FSB has decided to follow this guideline for SWE-033 thru SWE-035.</i></p> <p><i>However, for SWE-036 thru SWE-048 FSB has decided to consider the software supplier to be the IPDT because similar requirements are throughout 7150.2 that would apply to the IPDT, and it's likely that the mission Project will impose this set of requirements on the IPDT. FSW team compliance to all of these requirements is considered to be YES.</i></p> <p><i>Please keep the above in mind when responding to requirements SWE-033 through SWE-048.</i></p>				

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[SWE-033]	<p>The project shall assess options for acquisition against analysis of appropriate criteria to include risk, cost, and benefits for each option listed below:</p> <ul style="list-style-type: none"> a Acquire an off-the-shelf software product that satisfies the requirement. b Develop the software product or obtain the software service internally. c Develop the software product or obtain the software service through contract. d A combination of a, b, and c above. e Enhance an existing software product or service. 	<p>Justification for COTS & equipment is usually:</p> <ul style="list-style-type: none"> • making in-house isn't feasible due to cost/schedule • familiarity with the vendor product • evaluation of the product by in-house experts. <p>SRR, PDR Templates (tbs)</p>	SRR, PDR	FSW PDL
[SWE-034]	The project shall define and document or record the acceptance criteria and conditions for the software.	FSW Product Plan Template	Explain generic acceptance criteria for procurement of COTS & equipment in the FSW Product Plan	FSW PDL
[SWE-035]	For new contracts the project shall establish a procedure for software supplier selection including proposal evaluation criteria.	FSW Product Plan Template	Explain generic procurement procedures for COTS & equipment in the FSW Product Plan	FSW PDL
[SWE-036]	The project shall determine which software processes, activities, and tasks are appropriate for the project.	FSW Product Plan Template	Entire IPDT is to follow FSB FSW Standards and Guidelines	FSW PDL
[SWE-037]	<p>The project shall define the milestones at which the software supplier(s) progress will be reviewed and audited as a part of the monitoring of the acquisition.</p> <p>Note: All known contract milestones are expected to be included in the resulting contract.</p>	FSW Product Plan Template	<ul style="list-style-type: none"> • Mission Reviews • FSW SRR, PDR, CDR • Project Monthly Status • Annual POP replans 	FSW PDL
Software Contract Requirements				
[SWE-038]	<p>The project shall document software acquisition planning decisions.</p> <p>Note: This may be in an acquisition plan or in another project planning document.</p>	<p>FSW BOE Template (TBS)</p> <p>FSW Product Plan Template</p>	<ul style="list-style-type: none"> • FSW BOE, • FSW Product Plan • Annual POP replans 	FSW PDL
[SWE-039]	The project shall require the software supplier(s) to provide insight into software development and test activities, including monitoring integration and verification adequacy, trade study data, auditing the software development process, and participation in all software reviews and technical interchange meetings.	FSW Product Plan Template	Stakeholder involvement is key to FSW Standard Processes	FSW PDL
[SWE-040]	The project shall require the software supplier(s) to provide NASA all software products and software process tracking information, in electronic format, including all software development and management metrics.	FSW Product Plan Template	IPDT products are available to stakeholders on request	FSW PDL

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[SWE-041]	The project shall require the software supplier(s) to notify the project, in the response to the Request for Proposals, as to whether open source software will be included in code developed for the project.	FSW Product Plan Template	Identify Open Source products within FSW BOE & Product Plan, and at all FSW Reviews.	FSW PDL
[SWE-042]	The project shall require the software supplier(s) to provide NASA with electronic access to the source code developed for the project, including modified off-the-shelf software and non-flight software (ground test software, simulations, ground analysis software, ground control software, science data processing software, hardware manufacturing software, or other).	FSW Product Plan Template	IPDT products are available to stakeholders on request	FSW PDL
[SWE-043]	The project shall require the software supplier to track all software changes and provide the data for the project's review.	FSW Product Plan Template	FSW Requirements Database FSW DCR Database	FSW PDL
[SWE-044]	The project shall require the software supplier(s) to provide software metric data as defined in the project's Software Metrics Report. Note: The requirements for the content of the Software Metric Report are defined in Chapter 5 – SWE-117).	FSW Product Plan Template FSB Measurement, Analysis and Reporting Standard FSB Metrics Collection and Storage Procedure Template (TBS)	Monthly Project Status IPDT Metrics Collection and Storage Procedure	FSW PDL
[SWE-045]	The project shall participate in any joint NASA/contractor audits of the software development process and software configuration management process.	FSW Product Plan Template FSB will support as requested	IPDT will support audits as defined/scheduled	FSW PDL
[SWE-046]	The project shall require the software supplier(s) to provide a software schedule for the project's review and updates as requested.	<ul style="list-style-type: none"> • FSW Product Plan Template • FSB BSR schedule template • High level IPDT schedule in BSRs with dependencies is to be provided to project for inclusion in their scheduling tool. 	<ul style="list-style-type: none"> • FSW Product Plan contains initial baseline • Updates at monthly Project Sstatus Reviews • High level schedule maintained at Project level 	FSW PDL
[SWE-047]	The project shall require the software supplier(s) to make available, electronically, the software traceability data for the project's review.	FSW Product Plan Template	FSW RTTM	FSW PDL
[SWE-048]	The project shall document in the solicitation the software processes, activities, and tasks to be performed by the supplier.	FSW Product Plan Template	FSW Product Plan	FSW PDL

Acquisition requirements end here.

The 'project' in requirements below refers to the in-house FSW IPDT.

Software Requirements

[SWE-049]	The project shall document the software requirements. Note: The requirements for the content of each Software Requirement Specification and Data Dictionary are defined in Chapter 5 - SWE-109.	<ul style="list-style-type: none"> • FSW Requirements Template • FSW Requirements Management Process 	<ul style="list-style-type: none"> • FSW Requirements Doc. • MKS FSW Requirements Database • Data Dictionary = T&C DB plus flight parameters DB 	FSW PDL FSW DTLs
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[SWE-050]	The project shall identify, develop, document, approve, and maintain software requirements based on analysis of customer and other stakeholder requirements and the operational concepts.	FSW Product Plan Template	<ul style="list-style-type: none"> • Project-level Parent Reqmts. • FSW FSW Reqmts. Development Process • FSW Requirements Doc. as output from MKS • FSW Team baselining of requirements for each build once build development begins • FSW DCRs and FSW IRB process • Project level baselining of requirements doc. • Project-level CCRs and Project CCB (as required) 	FSW PDL FSW DTLs
[SWE-051]	The project shall perform software requirements analysis based on flowed-down and derived requirements from the top-level systems engineering requirements and the hardware specifications and design. Note: This analysis is for safety criticality, correctness, consistency, clarity, completeness, traceability, feasibility, verifiability, and maintainability. This includes the allocation of functional and performance requirements to functions and subfunctions.	FSW Product Plan Template	<ul style="list-style-type: none"> • Project-level Parent Reqmts. • Flight hardware specs and ICDs • MKS FSW RTM 	FSW PDL FSW DTLs
[SWE-052]	The project shall perform, document, and maintain bi-directional traceability between the software requirement and the higher level requirement. Note: The project should identify any orphaned or widowed requirements (no parent or no child) associated with reused software.		MKS FSW RTM from & to Parent Requirement docs.	FSW PDL FSW DTLs
[SWE-053]	The project shall collect and manage changes to the software requirements. Note: The project should analyze and document changes to requirements for cost, technical, and schedule impacts.		<ul style="list-style-type: none"> • MKS FSW DCR system • MKS FSW Reqmts. mgmt. 	FSW PDL FSW DTLs
[SWE-054]	The project shall identify inconsistencies between requirements and project plans and software products and initiate corrective actions. Note: A verification matrix supports the accomplishment of this requirement.		<ul style="list-style-type: none"> • MKS FSW RTM • PDL to identify significant inconsistencies between reqmts. and cost/schedule plans. • PDL to report significant reqmts. changes to 582 mgmt. for potential CCRs to the Project CCB or replanning of costs/schedules with the Project. • Risk may be developed at FSB level and also, possibly, at the Project level. 	FSW PDL

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[SWE-055]	The project shall perform requirements validation to ensure that the software will perform as intended in the customer environment. Note: This should include confirmation that the requirements meet the needs and expectations of the customer.		<ul style="list-style-type: none"> FSW requirements inspections FSW SRR includes all stakeholders FSW TTL and relevant stakeholders reviews reqmts. completeness in conjunction with FSW system test scenarios. 	FSW PDL FSW DTL FSW TTL
Software Design				
[SWE-056]	The project shall document the software design. Note: The requirements for the content of the software design description and interface design description are defined in Chapter 5 – SWE-111.	FSW Design Reviews satisfy Design Doc. reqmts.	<ul style="list-style-type: none"> FSW PDR FSW CDR Design products for code reviews FSW User Guides 	FSW DTLs
[SWE-057]	The project shall transform the allocated and derived requirements into a documented architectural design.	FSW Design Reviews satisfy Design Doc. reqmts.	FSW PDR design packages	FSW DTLs
[SWE-058]	The project shall develop and record a detailed design based on the architectural design that describes the lower level units so that they can be coded, compiled, and tested.	FSW Design Reviews satisfy Design Doc. reqmts.	FSW CDR design packages	FSW DTLs
[SWE-059]	The project shall perform and maintain bi-directional traceability between the software requirements and the software design.	FSW Component name is adequate	MKS FSW RTM - Requirements are traced to FSW component.	FSW DTLs
Software Implementation				
[SWE-060]	The project shall implement the software design into software code.	<ul style="list-style-type: none"> FSW Design Guidelines FSW Coding Standards 		FSW DTLs
[SWE-061]	The project shall ensure that software coding methods, standards, and/or criteria are adhered to and verified.	FSW Code Inspections Standard (TBS)	FSB Code Inspections	FSW DTLs
[SWE-062]	The project shall ensure that the software code is unit tested per the plans for software testing.	FSW Unit Test Standards	FSW Unit Tests	FSW DTLs
[SWE-063]	The project shall provide a Software Version Description document for each software release. Note: The requirements for the content of the Software Version Description document are defined in Chapter 5 – SWE-116.	FSW VDD Template FSW Delivery Letter Template	<ul style="list-style-type: none"> FSW VDD FSW Delivery Letter 	FSW DTLs
[SWE-064]	The project shall provide and maintain traceability from software design to the software code.	FSW Component name is adequate	MKS FSW RTM -- Design is traced to FSW component.	FSW DTLs

Req #	Requirement	FSB Reference	FSW Team Compliance	FSW Resp.
Software Testing				
[SWE-065]	<p>The project shall provide:</p> <ul style="list-style-type: none"> a Software Test Plan(s). b Software Test Procedures. c Software Test Reports. <p>Note: The requirements for the content of the Software Test Plan, Software Test Procedures, and Software Test Reports are defined in Chapter 5- SWE-104, 114, 118.</p>	<ul style="list-style-type: none"> • FSW Test Plan Template • FSW Test artifact Templates 	<ul style="list-style-type: none"> • FSW Test Plan • FSW Test artifacts 	FSW TTL
[SWE-066]	<p>The project shall perform software testing as defined in the Software Test Plan.</p> <p>Note: Testing could include software integration testing, systems integration testing, end-to-end testing, acceptance testing, white box testing, black box testing, decision and path analysis, statistical testing, stress testing, performance testing, regression testing, qualification testing, simulation, and others. Automated testing tools should also be considered..</p>	FSW Test Plan Template	FSW Test Program implemented according to FSW Test Plan	FSW TTL
[SWE-067]	The project shall ensure that the implementation of each software requirement is verified to the requirement.	FSW Test Plan Template	<ul style="list-style-type: none"> • FSW Build Verification • FSW Test Artifacts 	FSW TTL
[SWE-068]	The project shall evaluate test results and document the evaluation.	FSW Test Plan Template	FSW Test Reports and Test Results Reviews/Approvals	FSW TTL
[SWE-069]	The project shall document defects identified during testing and track to closure.	<ul style="list-style-type: none"> • FSW Test Plan Template • FSW DCR Requirements Standard 	<ul style="list-style-type: none"> • MKS DCR process • FSW IRB process 	FSW TTL FSW PDL
[SWE-070]	The project shall test, validate, and certify software models, simulations, and analysis tools.	FSW Testbed validation is described in the FSW Product Plan and FSW Test Plan (plus GDS Test Plan) – ALL TBS	Hardware interfaces, models and tools are unit tested by the developer, integration tested with the FSW builds, and then validated in conjunction with FSW test program. FSW Testbed is validated in conjunction with FSW AT.	FSW PDL
[SWE-071]	The project shall update Software Test Plan(s) and Software Test Procedure(s) to be consistent with software requirements.	FSW Test Plans do not reference specific FSW test procedures → no Test Plan update required	<ul style="list-style-type: none"> • MKS FSW DCRs against requirements flow to FSW test team and stay open until tests are completed. • MKS FSW RTTM to identify affected tests 	FSW TTL

Req #	Requirement	FSB Reference	FSW Team Compliance	FSW Resp.
[SWE-072]	The project shall provide and maintain traceability from the Software Test Procedures to the software requirements.	<i>What is the right reference for RTTM attribute fields?</i>	<ul style="list-style-type: none"> FSW RTTM FSW Build-tests identify individual reqmts. being tested with automated verifiers when reqmts. pass tests. 	FSW TTL
[SWE-073]	The project shall ensure that the software system is validated on the targeted platform or high-fidelity simulation.	FSW Test Plan Template	<ul style="list-style-type: none"> Entire FSW System Test program uses FlatSat – highest fidelity testbed. FSW AT is on FlatSat. 	FSW TTL
Software Operations, Maintenance, and Retirement				
[SWE-074]	The project shall document the software maintenance plans in the Software Maintenance Plan document. Note: The requirements for the content of the Software Maintenance Plan are defined in Chapter 5 – SWE-105.	FSW Maintenance Plan Template	FSW Maint. Plan developed one year before launch. Approvals include FSW PDL, FSB, Operations and the mission development plus operations projects.	FSW MTL
[SWE-075]	The project shall plan software acceptance, operation, maintenance, and retirement activities.	<ul style="list-style-type: none"> FSW Product Plan Template FSW Test Plan STRR Template FSW Maintenance Plan Template 	<p>FSW Acceptance Criteria are in FSW Product Plan</p> <p>FSW System Test Readiness Review describes AT.</p> <p>FSW Operations are responsibility of FOT.</p> <p>FSW Maint. Plan includes retirement activities.</p>	<p>FSW PDL</p> <p>FSW TTL</p> <p>FSW MTL</p>
SWE-076]	The project shall implement software operations, maintenance, and retirement activities as defined in the respective plans.		<ul style="list-style-type: none"> FSW Maintenance Team Flight Operations Team 	<p>FSW PDL</p> <p>FSW MTL</p>

Req #	Requirement	FSB Reference	FSW Team Compliance	FSW Resp.
[SWE-077]	<p>The project shall complete and deliver the software product to the customer with appropriate documentation to support the operations and maintenance phase of the software life cycle.]</p> <p>Note: Delivery includes, as applicable, Software User's Manual (as defined in Chapter 5= SWE-115), source files, executable software, procedures for creating executable software, procedures for modifying the software, and a Software Version Description. Open source software licenses should be reviewed by Center Chief of Patent/Intellectual Property Counsel before being accepted into software development projects. Other documentation that should be considered for delivery is:</p> <ol style="list-style-type: none"> Summary and status of all accepted Change Requests to the baselined Software Requirements Specifications. Summary and status of all major software capability changes since baselining of the Software Design Documents. Summary and status of all major software tests (including development, verification, and performance testing). Summary and status of all Discrepancy Reports written against the software. Summary and status of all software requirements deviations and waivers. Summary and status of all software user notes. Summary and status of all quality measures historically and for this software. Definition of open work, if any. Software configuration records defining the verified and validated software, including requirements verification data (e.g., requirements verification matrix). Final version of the software documentation, including the final Software Version Description document(s). Summary and status of any open software-related risks. 	Templates for each product in next column	<ul style="list-style-type: none"> FSW Reqmts. doc. FSW VDD FSW UG FSW Maintenance Readiness Checklist FSW Lab move and lab recertification checklist FSW In-orbit Installation & Check-out Procedures 	<p>FSW PDL</p> <p>FSW DTL</p> <p>FSW MTL</p> <p>FSW LM</p>
[SWE-078]	The project shall deliver to the customer the as-built documentation to support the operations and maintenance phase of the software life cycle.		<p>MKS As-built FSW Reqmts.</p> <p>FSW UG</p>	<p>FSW PDL</p> <p>FSW DTLs</p>
Software Configuration Management				
[SWE-079]	<p>The project shall develop a Software Configuration Management Plan that describes the functions, responsibilities, and authority for the implementation of software configuration management for the project.</p> <p>Note: The plan may be a part of the project configuration management plan with required content of the plan defined in Chapter 5 – SWE-103.</p>	FSW CM Plan Template	FSW CM Plan	<p>FSW PDL</p> <p>(FSW DTL)</p>

Req #	Requirement	FSB Reference	FSW Team Compliance	FSW Resp.
[SWE-080]	The project shall track and evaluate changes to software products. Note: The project can use a Software Change Request or software problem tracking system. Software Change Requests/Problem Reports should be documented per the requirements in Chapter 5 – SWE-113.	FSW DCR Requirements Standard	FSW CM Plan MKS FSW DCR Process	FSW PDL FSW DTLs
[SWE-081]	The project shall identify the software configuration items (e.g., software documents, code, data, scripts) and their versions to be controlled for the project.	FSW CM Plan Template	FSW CM Plan	FSW PDL FSW DTLs
[SWE-082]	The project shall establish and implement procedures designating the levels of control each identified configuration item must pass through; the persons or groups with authority to authorize changes and to make changes at each level; and the steps to be followed to request authorization for changes, process Change Requests, track changes, distribute changes, and maintain past versions.	FSW CM Plan Template FSW CM Procedures Template (TBS)	FSW CM Plan MKS FSW DCR Process FSW IRB	FSW PDL FSW DTLs FSW CME
[SWE-083]	The project shall prepare and maintain records of the configuration status of configuration items. Note: Configuration status accounting generates and/or maintains records of the status and contents of the software throughout the life cycle. This function keeps track of the changes and the contents of versions and releases..	FSW CM Plan Template	MKS CM system	FSW CME
[SWE-084]	The project shall ensure that software configuration audits are performed to determine the correct version of the configuration items and verify that they conform to the documents that define them.	FSW CM Plan Template (580 PCA Audit Checklist) (580 FCA Audit Checklist) 582 Tailored Audit Checklists (TBS)	MKS CM system Use 580 checklists until 582 tailored versions are baselined	FSW DTL FSW CME
[SWE-085]	The project shall establish and implement procedures for the storage, handling, delivery, release, and maintenance of deliverable software products.	FSW CM Procedures Template (TBS)	FSW CM Plan FSW CM Procedures	FSW PDL FSW DTLs
Risk Management				
[SWE-086]	The project shall identify, analyze, plan, track, control, communicate, and document software risks (potential issues, hazards, threats, and vulnerabilities) in accordance with NPR 7120.5, NASA Program and Project Management Processes and Requirements and NPR 8000.4, Risk Management Procedural Requirements.	<ul style="list-style-type: none"> • FSW Product • Plan Template • FSB Risks Tool • FSW BSR Template 	<ul style="list-style-type: none"> • FSW Product Plan • FSB Risks Tool • FSB BSRs • FSW Project Reporting (subset of FSB risks) 	FSW PDL FSW DTLs FSW TTL

Req #	Requirement	FSB Reference	FSW Team Compliance	FSW Resp.
Peer Reviews/Inspections				
[SWE-087]	<p>The project shall ensure peer reviews are performed for:</p> <ul style="list-style-type: none"> a Software Requirements. b Software Test Plans. c Any design and code items that the project identified for peer review according to the software development plans. <p>Note: Safety and mission-success related design and code components should be peer reviewed.</p>		<ul style="list-style-type: none"> • FSW Reqmts Inspections • SRR, PDR, CDR, STRR (remember safety discussions) • FSW Code Reviews 	<p>FSW PDL</p> <p>FSW DTLs</p> <p>FSW TTL</p>
[SWE-088]	<p>The project shall, for each planned peer review:</p> <ul style="list-style-type: none"> a Use a checklist to evaluate the work products. b Use established readiness and completion criteria. c Track actions identified in the reviews until they are resolved. 	<p>Templates and Tools satisfy checklist reqmt.</p> <ul style="list-style-type: none"> • FSW Requirements Inspection Standard • FSW SRR, PDR, CDR, STRR Templates • FSW Code Inspection Standard (TBS) • FSB RFA Tool 	<p>FSB FSW Requirements Inspection</p> <p>MKS FSW Actions Tracking</p> <p>FSW RFA database</p>	<p>FSW PDL</p> <p>FSW DTLs</p> <p>FSW TTL</p>
[SWE-089]	<p>The project shall, for each planned peer review, record basic measurements.</p> <p>Note: The requirements for the content of the Software Inspection/Peer Review Report are defined in Chapter 5 – SWE-119.</p>	<ul style="list-style-type: none"> • FSW RFA database • FSB BSR Template 	<ul style="list-style-type: none"> • MKS FSW Actions Track'g • FSW RFA Tracking • FSB BSRs 	<p>FSW PDL</p> <p>FSW DTLs</p> <p>FSW TTL</p>
Software Measurement				
[SWE-090]	<p>The project shall establish and document specific measurement objectives for their project.</p>	<p>FSW Product Plan Template</p> <p>FSB Measurement, Analysis and Reporting Standard</p>	IPDT Product Plan	FSW PDL
[SWE-091]	<p>The project shall select and record the selection of specific measures in the following areas:</p> <ul style="list-style-type: none"> a. Software progress tracking. b. Software functionality. c. Software quality. d. Software requirements volatility. e. Software characteristics. <p>Note: Metrics reports should be documented per the metrics report requirements of Chapter 5- SWE-117.</p>	<p>FSB Measurement, Analysis and Reporting Standard</p> <p>FSB BSR Template</p>	FSB BSRs	<p>FSW PDL</p> <p>FSW DTLs</p> <p>FSW TTL</p>
[SWE-092]	<p>The project shall specify and record data collection and storage procedures for their selected software measures and collect and store measures accordingly.</p> <p>Note: Data should be maintained in the NASA process asset library.</p>	<p>FSB Metrics Collection and Storage Procedures Template (TBS)</p>	<p>IPDT Metrics Collection and Storage Procedures</p> <p>Data archived in FSB Metrics Archive (FSWMAIN2)</p>	<p>FSW PDL</p> <p>FSW DTLs</p> <p>FSW TTL</p>
[SWE-093]	<p>The project shall analyze software measurement data collected using documented project-specified and Center/organizational analysis procedures.</p>	<p>FSB Measurement, Analysis and Reporting Standard</p>	FSB BSRs	FSB

Req #	Requirement	FSB Reference	FSW Team Compliance	FSW Resp.
[SWE-094]	The project shall report measurement analysis results periodically and allow access to measurement information by Center-defined organizational measurement programs.		Metrics summaries supplied to SED on request	FSB
[SWE-095]	Each NASA Mission Directorate shall establish its own software measurement system to include the minimum reporting requirements in SWE-091.			n/a
[SWE-096]	Each NASA Mission Directorate shall identify and document the specific measurement objectives, the chosen specific measures, the collection procedures, and storage and analysis procedures.			n/a.
[SWE-097]	Each NASA Mission Directorate shall report their software measurement results to the Office of the Chief Engineer on a yearly basis.			n/a.
Best Practices				
[SWE-098]	The NASA Office of the Chief Engineer shall maintain an Agency-wide process asset library of applicable best practices. Note: The repository may contain information in many forms, including, but not limited to, websites, design principles, books, periodicals, presentations, and conference descriptions.			n/a.
[SWE-099]	Each Center shall review the contents of the process asset library to identify those practices that may have direct applicability and value to its software activities.			n/a
Training				
[SWE-100]	The NASA Chief Engineer and Center training organizations shall provide and fund training to advance software engineering practices and software acquisition.			n/a
[SWE-101]	Each Center shall maintain and implement a Software Training Plan(s) to advance its in-house software engineering capability and as a reference for its contractors. Note: The Software Training Plan should be documented per the Software Training Plan requirements of Chapter 5 – SWE-107. Centers should plan to meet or exceed the CMMI® SE/SW Maturity Level 3			n/a

Req #	Requirement	FSB Reference	FSW Team Compliance	FSW Resp.
Software Plans				
[SWE-102]	<p>The Software Development or Management Plan shall contain:</p> <ol style="list-style-type: none"> Project organizational structure showing authority and responsibility of each organizational unit, including external organizations (i.e., Safety and Mission Assurance, Independent Verification and Validation (IV&V), Independent Technical Authority (ITA), NASA Engineering and Safety Center (NESC)). The classification of each of the systems and subsystems containing software as defined in Appendix B. Tailoring compliance matrix for approval by the designated ITA Warrant Authority, if the projects has any variants, waivers or exceptions to this NPR. Engineering environment (for development, operation, or maintenance, as applicable), including test environment, library, equipment, facilities, standards, procedures, and tools. Work breakdown structure of the life cycle processes and activities, including the software products, software services, nondeliverable items to be performed, budgets, staffing, physical resources, software size, and schedules associated with the tasks. Management of the quality characteristics of the software products or services. Management of safety, security, privacy, and other critical requirements of the software products or services. Subcontractor management, including subcontractor selection and involvement between the subcontractor and the acquirer, if any. Verification and validation approach. Acquirer involvement. User involvement. Risk management. Security policy. Approval required by such means as regulations, required certifications, proprietary, usage, ownership, warranty, and licensing rights. Process for scheduling, tracking, and reporting. Training of personnel, including project unique software training needs. <p>[continued on next page]</p>	<p>FSB FSW Product Plan Template provides the initial plan which will be baselined by the Project CCB.</p> <p>FSB FSW BSR template provides the updates to the planning material over the life cycle.</p> <p><i>(o) FSW Product Plan template requires words for the process of scheduling, tracking and reporting. FSW CCB DCR 251.</i></p>	<p>FSW Product Plan</p> <p>FSW BSR</p>	FSW PDL

Req #	Requirement	FSB Reference	FSW Team Compliance	FSW Resp.
[SWE-102] cont.	<p>q. Software life cycle model including description of software integration and hardware/software integration processes, software delivery, and maintenance.</p> <p>r. Configuration management</p> <p>s. Software documentation tree.</p> <p>t. Peer review/inspection process of software work products.</p> <p>u. Process for early identification of testing requirements that drive software design decisions; e.g., special system level timing requirements/checkpoint restart.</p> <p>v. Software metrics.</p> <p>w. Content of software documentation to be developed on the project.</p> <p>Note: Verification approach includes:</p> <p>a. Identification of selected software verification procedures and criteria across the life cycle (e.g., peer review procedures, inspection procedures, re-inspection criteria, testing procedures).</p> <p>b. Identification of selected work products to be verified (e.g., peer reviews of requirements and test plans, peer reviews/inspections of critical code, testing code against requirements and design).</p> <p>c. Description of software verification environments that are to be established for the project (e.g., software testing environment, system testing environment, regression testing environment).</p> <p>d. Identification of where actual software verification records and analysis of the results will be documented (e.g., test records, peer review records, inspection records), and where software verification corrective action will be documented.</p> <p>Note: Validation approach includes:</p> <p>a. Identification of selected software validation procedures and criteria across the life cycle (e.g., prototyping, user groups, simulation, analysis, acceptance testing, operational demonstrations).</p> <p>b. Identification of selected work products to be validated (e.g., user groups reviewing requirements and prototypes, acceptance testing of software product, operational demonstrations of software product).</p> <p>c. Description of software validation environments that are to be established for the project (e.g., simulators for operational environment).</p> <p>d. Identification of where actual software validation records and analysis of the results will be documented (e.g., user group records, prototyping records, acceptance testing records) and where software validation corrective action will be documented.</p>	<p>(s) FSBs FSW Product Plan template requires words for development of a FSW Document Tree. FSW CCB DCR 250.</p> <p>(u) FSW Product Plan template requires words explaining the early ID of test requirements associated with I&T.</p>		

Req #	Requirement	FSB Reference	FSW Team Compliance	FSW Resp.
[SWE-103]	<p>The Software Configuration Management Plan shall contain:</p> <ul style="list-style-type: none"> a The project organization(s) within which Software Configuration Management is to apply. b Responsibilities of the software configuration management organization. c References to the software configuration management policies and directives that apply to the project. d All functions and tasks required to manage the configuration of the software, including configuration identification, configuration control, status accounting, and configuration audits and reviews. e Schedule information, which establishes the sequence and coordination for the identified activities and for all events affecting the Plan's implementation. f Resource information, which identifies the software tools, techniques, and equipment necessary for the implementation of the activities. g Plan maintenance information, which identifies the activities and responsibilities necessary to ensure continued planning during the life cycle of the project. h Release management and delivery. 	<p>FSB FSW CM Plan Template</p> <p><i>(e) FSW CM Plan template requires words regarding the sequence and coordination of events affecting the Plan's implementation. FSW CCB DCR 254.</i></p> <p><i>(g) FSW CM Plan template requires words explaining the activities and responsibilities nec. to ensure continued planning during the life cycle of the FSW development. FSW CCB DCR 255.</i></p>	FSW CM Plan	FSW PDL
[SWE-104]	<p>The Software Test Plan shall include:</p> <ul style="list-style-type: none"> a Test levels. b Test types (e.g., unit testing, software integration testing, systems integration testing, end-to-end testing, acceptance testing, regression testing). c Test classes. d General test conditions. e Test progression. f Data recording, reduction, and analysis. g Test coverage (breadth and depth) or other methods for ensuring sufficiency of testing. h Planned tests, including items and their identifiers. i Test schedules. j Requirements traceability (or verification matrix). k Qualification testing environment, site, personnel, and participating organizations. 	<p>FSW Test Plan template</p> <p>FSB BSR template</p> <p><i>(g) FSW Test Plan template requires words explaining the breadth & depth of test coverage and methods for ensuring sufficiency of testing. FSW CCB DCR 258.</i></p> <p><i>(i) FSW Test Plan template requires words for including the current FSW test schedule within the FSW Test Plan at the time of baselining the document at Project CCB; and that updates to the test schedule over the mission life cycle will be provided within the FSW BSR. FSW CCB DCR 259.</i></p>	FSW Test Plan	FSW TTL

Req #	Requirement	FSB Reference	FSW Team Compliance	FSW Resp.
[SWE-105]	<p>The Software Maintenance Plan shall include:</p> <p>a. Plan information for the following activities:</p> <ul style="list-style-type: none"> (1) Maintenance process implementation. (2) Problem and modification analysis. (3) Modification implementation. (4) Maintenance review/acceptance. (5) Migration. (6) Software Retirement. (7) Software Assurance. <p>b. Specific standards, methods, tools, actions, procedures, and responsibilities associated with the maintenance process. In addition, the following elements are included:</p> <ul style="list-style-type: none"> (1) Development and tracking of required upgrade intervals, including implementation plan. (2) Approach for the scheduling, implementation, and tracking of software upgrades. (3) Equipment and labs required for software verification and implementation. (4) Updates to documentation for modified COTS or non-COTS software. (5) Licensing agreements for COTS. (6) Plan for and tracking of operational backup software. (7) Approach for the implementation of modifications to operational software (e.g., testing of software in development lab prior to operational use). (8) Approach for software delivery process including distribution to facilities and users of the software products and installation of the software in the target environment (including, but not limited to, spacecraft, simulators, Mission Control Center, and ground operations facilities). (9) Approach for providing NASA access to the software version description data; e.g., revision number, licensing agreement. 	FSB FSW Maintenance Plan template	FSW Maintenance. Plan	FSW MTL
[SWE-106]	The Software Assurance Plan(s) shall be written per NASA-STD-8739.8, NASA Software Assurance Standard.		QA Plan	QA/300

Req #	Requirement	FSB Reference	FSW Team Compliance	FSW Resp.
[SWE-107]	<p>The Center Software Training Plan shall include:</p> <ul style="list-style-type: none"> a. Responsibilities. b. Implementation. c. Records and forms. d. Training resources. e. Minimum training requirements for software personnel. f. Training class availabilities 			n/a
[SWE-108]	<p>The Center Software Engineering Improvement Plans shall include:</p> <ul style="list-style-type: none"> a. Process improvement goal(s). b. Scope of process improvement. c. All Center organizations responsible for the performance of mission-critical software development, management, and acquisition. d. The Center's tactic for phasing in improvements (e.g., domain phasing and organizational phasing). e. Ownership of Center Software Engineering Improvement Plan. f. The Center's tactic for monitoring Center Software Engineering Improvement Plan progress including responsibilities. g. Strategies and objectives. h. The Center's tactic for supporting the implementation of all strategies of the NASA Software Engineering Initiative Implementation Plan. i. Schedule. 			n/a

Req #	Requirement	FSB Reference	FSW Team Compliance	FSW Resp.
[SWE-109]	<p>The Software Requirements Specification shall contain:</p> <ul style="list-style-type: none"> a. System overview. b. CSCI requirements. <ul style="list-style-type: none"> (1) Functional requirements. (2) Required states and modes. (3) External interface requirements. (4) Internal interface requirements. (5) Internal data requirements. (6) Adaptation requirements. (7) Safety requirements. (8) Performance and timing requirements. (9) Security and privacy requirements. (10) Environment requirements. (11) Computer resource requirements. <ul style="list-style-type: none"> (a) Computer hardware resource utilization requirements. (b) Computer software requirements. (c) Computer communications requirements. (12) Software quality characteristics. (13) Design and implementation constraints. (14) Personnel-related requirements. (15) Training-related requirements. (16) Logistics-related requirements. (17) Packaging requirements. (18) Precedence and criticality of requirements. c. Qualification provisions. d. Requirements traceability and verification data. e. Requirements partitioning for phased delivery. f. Testing requirements that drive software design decisions, e.g., special system level timing requirements/checkpoint restart. 	FSW Requirements Doc. Template	<p>FSW Requirements Doc.</p> <p>FSW Requirements in MKS</p> <p>(6) FSW Requirements adapted from requirements obtained from the FSRL shall follow the FSRL rules for reqmts. reuse.</p> <p>(14) FSW commands, telemetry, events and diagnostic features represent Personnel-related requirements.</p> <p>(15) FSW has no training requirements within the FSW product other than those mentioned in (14).</p> <p>(16) FSW logistics requirements are defined within the FSW Product Plan for the various FSW test environments.</p> <p>(17) Packaging requirements are not relevant beyond FSW memory and CPU requirements. Delivery requirements are within the FSW Product Plan.</p> <p>(18) FSW requirements are treated similarly in terms of test verification such that precedence and criticality are not relevant concepts.</p> <p><i>e The FSW Build Plan is within the FSW Product Plan and is maintained over time in the FSW BSR. The Build Plan is defined to facilitate readiness of appropriate deliveries to I&T.</i></p> <p><i>FSW CCB DCR 266</i></p>	FSW PDL

Req #	Requirement	FSB Reference	FSW Team Compliance	FSW Resp.
[SWE-110]	<p>The Software Data Dictionary shall include:</p> <ol style="list-style-type: none"> Channelization data (e.g., bus mapping, vehicle wiring mapping, Multiplexer-Demultiplexer hardware channelization). I/O variables. Rate group data. Raw and calibrated sensor data. Telemetry format/layout and data. Data recorder format/layout and data. Command definition (e.g., on-board, ground, test specific). Effector command information. Operational limits (e.g., maximum/minimum values, launch commit criteria information). 		CMD and TLM Database definitions	FSW PDL
[SWE-111]	<p>The Software Design Description shall include:</p> <ol style="list-style-type: none"> CSCI-wide design decisions/trade decisions. CSCI architectural design. CSCI decomposition and interrelationship between components. <ol style="list-style-type: none"> CSCI components: <ol style="list-style-type: none"> Description of how the software item satisfies the software requirements, including algorithms, data structures, and functional decomposition. Software item input/output description. Static/architectural relationship of the software units. Concept of execution including data flow, control flow, and timing. Requirements traceability. CSCI's planned utilization of computer hardware resources. Rationale for software item design decisions/trade decisions including assumptions, limitations, safety and reliability related items/concerns or constraints in design documentation. Interface design. CSCI Implementation Plan. 		FSW PDR, CDR packages	FSB PDR, CDR templates

Req #	Requirement	FSB Reference	FSW Team Compliance	FSW Resp.
[SWE-112]	<p>The Interface Design Description shall include:</p> <ol style="list-style-type: none"> Priority assigned to the interface by the interfacing entity(ies). Type of interface (i.e., real-time data transfer, storage-and-retrieval of data) to be implemented. Specification of individual data elements, format, and data content including bit-level descriptions of data interface that the interfacing entity(ies) will provide, store, send, access, and receive. Specification of data element assemblies, format, and data content including bit-level descriptions of data interface that the interfacing entity(ies) will provide, store, send, access, receive. Specification of communication methods that the interfacing entity(ies) will use for the interface. Specification of protocols the interfacing entity(ies) will use for the interface. Other specifications, such as physical compatibility of the interfacing entity(ies). Traceability from each interfacing entity to the system or CSCI requirements addressed by the entity's interface design, and traceability from each system or CSCI requirement that affects an interface. Interface compatibility. 	<p><i>LRO ICD contents would be the ideal basis for a template. (TBS)</i></p>	FSW ICDs	FSW PDL

Req #	Requirement	FSB Reference	FSW Team Compliance	FSW Resp.
[SWE-113]	<p>The Software Change Request/Problem Report shall contain:</p> <ol style="list-style-type: none"> Identification of the software item. Description of the problem or change to enable problem resolution or justification for and nature of change, including: assumptions/constraints, change to correct software error. Originator of Software Change Request/Problem Report, and originator's assessment of priority/severity. Description of the corrective action taken to resolve the reported problem or analysis and evaluation of change, including impact to safety, schedules, cost, products, and test. Life cycle phase in which problem was discovered or in which change was requested. Approval or disapproval of Software Change Request/Problem Report . Verification of the implementation and release of modified system. Date problem discovered Status of problem <p>Note: The Software Change Request/Problem Report provides a means for identifying and recording the resolution to software anomalous behavior, process noncompliance with plans and standards, and deficiencies in life cycle data, or for identifying and recording the implementation of a change or modification in a software item.</p>	<p>FSB DCR Requirements Standard</p> <p>Also defined within the FSW CM Plan template</p>	MKS FSW DCR process	FSW PDL
[SWE-114]	<p>The Software Test Procedures shall contain:</p> <ol style="list-style-type: none"> Test preparations, including hardware and software. Test descriptions, including: <ol style="list-style-type: none"> Test identifier. System or CSCI requirements addressed by the test case. Prerequisite conditions. Test input. Instructions for conducting procedure. Expected test results, including criteria for evaluating results, and assumptions and constraints. Criteria for evaluating results. Requirements traceability. Identification of test configuration 	FSB Test Procedures Template	Test Procedures	FSW TTL

Req #	Requirement	FSB Reference	FSW Team Compliance	FSW Resp.
[SWE-115]	<p>The Software User Manual shall contain:</p> <ul style="list-style-type: none"> a. Software summary including: application, inventory, environment, organization and overview of operation, contingencies and alternate states and modes of operation, security and privacy, and assistance and problem reporting. b. Access to the software: first-time user of the software, initiating a session, and stopping and suspending work. c. Processing reference guide: capabilities, conventions, processing procedures, related processing, data backup, recovery from errors, malfunctions, emergencies, and messages. d. Assumptions, limitations, safety related items/concerns or constraints. 	<i>FSW UG Template (TBS)</i>	FSW UG (no FSB template)	FSW DTL
[SWE-116]	<p>The Software Version Description shall identify and provide:</p> <ul style="list-style-type: none"> a. Full identification of the system and software (i.e., numbers, titles, abbreviations, version numbers, and release numbers). b. Executable software (i.e., batch files, command files, data files, or other software needed to install the software on its target computer). c. Software life cycle data that defines the software product. d. Archive and release data. e. Instructions for building the executable software, including, for example, the instructions and data for compiling and linking and the procedures used for software recovery, software regeneration, testing, or modification. f. Data integrity checks for the executable, object code, and source code. g. Software product files (any files needed to install, build, operate, and maintain the software). 	FSB VDD template	VDD	FSW DTL

Req #	Requirement	FSB Reference	FSW Team Compliance	FSW Resp.
Software Report Requirements				
[SWE-117]	<p>The Software Metrics Report provides data to the project for the assessment of software cost, technical, and schedule progress. The Software Metrics Report shall contain as a minimum the following information tracked on a CSCI basis:</p> <ul style="list-style-type: none"> a. Software progress tracking measures. <p>Note: An example set of software progress tracking measures that meet 5.3.1.a include, but are not limited to:</p> <ul style="list-style-type: none"> a. Software resources such as budget and effort (planned vs. actual). b. Software development schedule tasks (e.g., milestones) (planned vs. actual). c. Implementation status information (e.g., number of computer software units in design phase, coded, unit tested, and integrated into computer software configuration item versus planned). d. Test status information (e.g., number of tests developed, executed, successfully passed). e. Number of replans/baselines performed. b. Software functionality measures. <p>Note: An example set of software functionality measures that meet 5.3.1.b include, but are not limited to:</p> <ul style="list-style-type: none"> a. Number of requirements included in a completed build/release (planned versus actual). b. Function points (planned vs. actual). c. Computer resource utilization in percentage of capacity. c. Software quality measures. <p>Note: An example set of software quality measures that meet 5.3.1.c include, but are not limited to:</p> <ul style="list-style-type: none"> a. Number of software Problem Reports/Change Requests (new, open, closed, severity). b. Review of item discrepancies (open, closed, and withdrawn). c. Number of peer reviews/software inspections (planned vs. actual). d. Peer review information (e.g., effort, review rate, defect data). e. Number of software audits (planned vs. actual). <p>[continued on next page]</p>	FSB BSR template	FSW BSR (monthly)	FSW PDL FSW DTL FSW TTL

Req #	Requirement	FSB Reference	FSW Team Compliance	FSW Resp.
[SWE-117 con't.)	<p>f. Software audit findings information (e.g., number and classification of findings).</p> <p>g. Software risks and mitigations.</p> <p>h. Number of requirements verified or status of requirements validation.</p> <p>d. Software requirement volatility.</p> <p>Note: An example set of software requirement volatility measures that meet 5.3.1.d include, but are not limited to:</p> <p>a. Number of software requirements.</p> <p>b. Number of software requirements changes (additions, modifications, deletions) per month.</p> <p>c. Number of "to be determined" items.</p> <p>e. Software product characteristics.</p> <p>Note: An example set of software product characteristics that meet 5.3.1.e include, but are not limited to:</p> <p>a. Project name.</p> <p>b. Language.</p> <p>c. Software domain (flight software, ground software, web application).</p> <p>d. Number of source lines of code by categories (new, slightly modified, COTS) - planned vs. actual.</p> <p>To the extent information regarding 5.3.1.a through 5.3.1.e of SWE-127 is not provided, the project will provide documented justification in the Software Metrics Report. Other information may be provided at the supplier's discretion to assist in evaluating the cost, technical, and schedule performance; e.g., innovative processes and cost reduction initiatives.</p>			

Req #	Requirement	FSB Reference	FSW Team Compliance	FSW Resp.
[SWE-118]	<p>The Software Test Report shall include:</p> <ul style="list-style-type: none"> a. Overview of the test results. <ul style="list-style-type: none"> (1) Overall assessment of the software as demonstrated by the test results. (2) Remaining deficiencies, limitations, or constraints detected by testing. (e.g., including description of the impact on software and system performance, the impact a correction would have on software and system design, and recommendations for correcting the deficiency, limitation, or constraint). (3) Impact of test environment. b. Detailed test results. <ul style="list-style-type: none"> (1) Project-unique identifier of a test and test procedure(s). (2) Summary of test results (e.g., including requirements verified). (3) Problems encountered. (4) Deviations from test cases/procedures. c. Test log. <ul style="list-style-type: none"> (1) Date(s), time(s), and location(s) of tests performed. (2) Test environment, hardware, and software configurations used for each test. (3) Date and time of each test-related activity, the identity of the individual(s) who performed the activity, and the identities of witnesses, as applicable. d. Rationale for decisions. 	FSB Test Execution Report Template	FSW Test Execution Reports	FSW TTL
[SWE-119]	<p>The Software Inspection/Peer Review Report shall include:</p> <ul style="list-style-type: none"> a. Identification information (including item being inspected, inspection type (e.g., requirements inspection, code inspection, etc), and inspection time and date). b. Summary on total time expended on each inspection/peer review (including total hour summary and time participants spent reviewing the product individually). c. Participant information (including total number of participants and participant's area of expertise). d. Total number of defects found (including the total number of major defects, total number of minor defects, and the number of defects in each type (e.g., accuracy, consistency, completeness, etc.)). e. Inspection results summary (i.e., pass, re-inspection required). f. Listing of all inspection defects. 	FSW Walk-through/Inspection Report template	FSW Inspection Reports	FSW DTL FSW TTL

Req #	Requirement	FSB Reference	FSW Team Compliance	FSW Resp.
Tailoring of Requirements				
[SWE-120]	For those cases in which a Center, project, or program, desires to apply specific or general practices that do not meet or exceed the requirements of this NPR, the Center shall recommend those alternate requirements for Agency Technical Authority approval with appropriate justification and Center ITA Manager concurrence.			n/a unless requested
[SWE-121]	Where approved the Center shall document the approved alternate requirement in the procedure controlling the development, acquisition and or deployment of the affected software.			n/a unless requested
Expertise of ITA Warrant Authority(s)				
[SWE-122]	<p>The designated ITA Warrant Authorities for this NPR for non-business and non-IT infrastructure systems shall be approved by the NASA Chief Engineer, in coordination with the NASA Chief Safety and Mission Assurance Officer.</p> <p>Note: The designated ITA Warrant Authorities for this NPR should be recognized NASA software engineering experts.</p>			n/a
[SWE-123]	The designated ITA Warrant Authorities for this NPR for business and IT-infrastructure systems shall be approved by the NASA Chief Information Officer.			n/a
[SWE-124]	The designated ITA Warrant Authority for this NPR shall comply with Office of the Chief Engineer direction for NASA Independent Technical Authority.			n/a
Compliance				
[SWE-125]	Each project with software components shall maintain a compliance matrix against requirements in this NPR including those delegated to other parties or accomplished by contract vehicles.	FSB 7150.2 Compliance Guideline (this document)	7150.2 Compliance Matrix	FSW PDL
[SWE-126]	<p>The designated ITA Warrant Authority for this NPR shall consider the following information when assessing waivers and variants from requirements in this NPR:</p> <ol style="list-style-type: none"> The list of Agency projects containing software. The classification of systems and subsystems containing software as defined in Appendix B. Applicable Center-level software directives that meet the intent of this NPR. Applicable contractor and subcontractor software policies and procedures that meet the intent of this NPR. Potential impacts to NASA missions. 			n/a

Req #	Requirement	FSB Reference	FSW Team Compliance	FSW Resp.
[SWE-127]	The designated ITA Warrant Authority for this NPR shall review and have concurrence approval for Center defined subsets of requirements denoted by "P(Center)" in the Requirements Mapping Matrix in Appendix D for the indicated Classes of software.			n/a
[SWE-128]	The designated ITA Warrant Authority shall keep records of projects and organizational compliances, waivers, variants, and exceptions against this NPR; and submit an annual report to the Office of Chief Engineer, Office of Safety and Mission Assurance, and the Chief Information Officer.			n/a
[SWE-129]	The Office of the Chief Engineer shall authorize appraisals against selected requirements in this NPR (or ITA approved alternative set of designated Center requirements) to check compliance.			n/a.